

trained specialist, and on its availability for emergency situations.

- It compares favorably with angiography since it is easier to interpret, is noninvasive, is easier to carry out in immobile patients with multiple injuries and takes little time in a well-organized department. Its pictorial detail is adequate for diagnosis in most cases. Angiography can be reserved for the relatively infrequent patient with equivocal findings on a scintigraphic study.

- False negative results of studies are most commonly due to a laceration with free intraperitoneal bleeding. This type of lesion does not create a mass in the spleen but becomes rapidly apparent from the clinical course. False positive studies may be due to preexisting lesions or to misinterpretation of an overlapping left liver lobe by an inexperienced reviewer.

- Concomitant liver images aid in evaluation of possible hepatic involvement.

Consequently, emergency radiocolloid scintigraphy is well suited to serve as the primary special radiologic technique in the workup of patients with suspected trauma of spleen or liver.

JAN K. SIEMSEN, MD  
NANCY TELFER, MD

#### REFERENCES

- Rosoff L, Cohen JL, Telfer N, et al: Injuries of the spleen. *Surg Clin North Am* 52:667-685, Jun 1972
- Nebesar RA, Rabinov KR, Potsaid MS: Radionuclide imaging of the spleen in suspected splenic injury. *Radiology* 110:609-614, Mar 1974
- Witek JT, Spencer RP, Pearson HA, et al: Diagnostic spleen scans in occult splenic injury. *J Trauma* 14:197-199, Mar 1974

## Radionuclide Scintigraphy in Cyanotic Heart Disease

QUANTITATION OF right-to-left shunting and determination of the distribution of pulmonary arterial flow can be easily achieved by nuclear medicine techniques. Following intravenous injection of 10 to 50 micron-sized particles of radioactive technetium ( $^{99m}\text{Tc}$ ) macroaggregated albumin (MAA), total body and lung imaging is carried out with a scintillation camera.

The relative distribution of MAA between the lungs is dependent upon partition of pulmonary arterial flow and is determined by the ratios of radioactivity in the lungs. The fraction of MAA

which bypasses the lungs to enter the systemic circulation equals right-to-left shunting and is determined as a percentage by: (total body "count" — total lung "count" divided by total body "count")  $\times 100$ . The albumin per test dose does not exceed 0.2 mg (usual volume is 0.1 ml with a dose of 200 to 400 microcuries) which gives a 6,000-fold safety factor for cerebral toxicity levels.

This procedure provides information useful in the clinical management of cyanotic heart disease. Detection of unilateral pulmonary hyperperfusion by scintigraphy is far more reliable than by usual inspection of chest radiograms where one lung must receive 2 to  $2\frac{1}{2}$  times the blood flow of the opposite before consistent detection is possible. Such pulmonary flow imbalance is particularly important to uncover if cardiac surgical procedures are planned or if a systemic-pulmonic anastomosis has been created. Preoperative quantitation of right-to-left shunting will serve as a baseline value for postoperative comparison and allows for objective evaluation of surgical results. Simultaneous determinations of right-to-left shunting and distribution of pulmonary arterial flow has resulted in detection of malfunctioning systemic-pulmonic anastomoses before any other diagnostic procedure. Well-functioning anastomoses reduce right-to-left shunting by increasing pulmonary blood flow to each lung, although sometimes unequally. Malfunctioning anastomoses do not significantly reduce right-to-left shunting and may cause unilateral pulmonary hyperperfusion. Nonfunctioning shunts do not decrease right-to-left shunting but may alter distribution of pulmonary flow. Perfusion lung scans alone are inadequate for evaluating shunt function as preferential nuclide accumulation may occur in either lung regardless of the functional status of the anastomosis.

This technique is carried out in less than 10 minutes, is safe and can be done serially in an outpatient situation. It provides information otherwise obtainable only in part by cardiac catheterization.

GARY F. GATES, MD

#### REFERENCES

- Gates GF, Orme HW, Dore EK, et al: Cardiac shunt assessment in children with macroaggregated albumin Technetium-99m. *Radiology* 112:649-653, Sep 1974
- Gates GF, Orme HW, Dore EK, et al: Surgery of congenital heart disease assessed by radionuclide scintigraphy. *J Thorac Cardiovasc Surg* 69:767-775, May 1975
- Gates GF, Orme HW, Dore EK, et al: The hyperperfused lung in congenital heart disease. *JAMA* (In Press)